



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/632,873	08/01/2003	Yunsang Kim	007354	4644
44182 7590 12/20/2005 MOSER, PATTERSON & SHERIDAN, LLP APPLIED MATERIALS INC 595 SHREWSBURY AVE SUITE 100 SHREWSBURY, NJ 07702			ALRT/ETCH/DRIE	
			EXAMINER	
			GEORGE, PATRICIA ANN	
			ART UNIT	PAPER NUMBER
			1765	
DATE MAILED: 12/20/2005				

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No. 10/632,873	Applicant(s) KIM ET AL.	
	Examiner Patricia A. George	Art Unit 1765	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 13 July 2005.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-13 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-13 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
 Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
 Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Claim Rejections - 35 USC § 112

The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Claims 1-13 stands rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. The following language in claim 1 is not clear: "comprising a fluorine-rich fluorocarbon or hydrofluorocarbon gas, a nitrogen-containing gas, and a hydrogen-rich hydrofluorocarbon gas;". Due to the use of both "and" and "or" the specific combination of component dgases is unclear. The claim could be interpreted to include anywhere from one (1) to three (3) additives.

In addition, the terminology of "rich" is considered to be a relative - term - of degree. It is not clear what specific fluorocarbons are encompassed by the phrase "fluorine-rich fluorocarbons", nor is is clear what specific hydrocarbons are encompassed by the phrase "hydrogen-rich hydrocarbons".

Claims 2-13 are indefinite because they directly or indirectly depend on claim 1.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

Claims 1-2, 3, 4-6, 9, and 12 are rejected under 35 U.S.C. 102(e) as being anticipated by Desphande et al (US Patent No. 6,869,542).

Desphande discloses a plasma etch process (col. 8, line 23) for selectively etching (col. 4, line 63) a layer of low-k dielectric material having a dielectric constant less than 4 (line 63, silicon dioxide has dielectric constant of 3.9), comprising:
Introducing into a plasma etch chamber (see col. 11, lines 36-37, then 60-61), in which the layer of low-k dielectric material is situated (67), an etching gas mixture (col. 12, line 27) comprising a fluorine-rich fluorocarbon (line 29) or hydrofluorocarbon gas (line 29), a nitrogen-containing gas (line 28), and a hydrogen-rich hydrofluorocarbon gas (line 29); and maintaining a plasma of the etching gas mixture (line 46) in the plasma etch chamber (line 47) to etch (line 45) the layer of low-k dielectric material (line 45).

As for claim 2, Desphande discloses the fluorine-rich fluorocarbon gas is CF₄ (col. 12, line 29), the nitrogen-containing gas is N₂ (line 28), and the hydrogen-rich hydrofluorocarbon gas is selected from the group consisting of CH₂F₂ (line 29), CH₃F (line 29), and mixtures thereof (line 29).

With respect to claim 3, since the reference discloses the etching gas it is considered to inherently encompass the same etching ability (i.e. accomplish the same etch rate).

As for claim 4, Desphande discloses the fluorine-rich fluorocarbon or hydrofluorocarbon gas is selected from the group consisting of CF.sub.4, C.sub.2F.sub.8, CHF.sub.3 (col. 12, line 29), and mixtures thereof (line 29).

As for claim 5, Desphande discloses a nitrogen-containing gas: N.sub.2 (col. 12, line 28).

As for claim 6, Desphande discloses hydrogen-rich hydrofluorocarbon gases: CH.sub.2F.sub.2 (col. 12, line 29), CH.sub.3F (line 29), and mixtures thereof (line 29).

As to claim 9, Desphande discloses a layer of low-k dielectric material that is: over a substrate (col. 9, lines 48-50), placed on a pedestal (see col. 11, line 67 to col. 12 line 1), in a plasma etch chamber (see col. 11, lines 36-37, then 60-61), that is maintaining a plasma of etching gas mixture (col. 12, line 27), comprising capacitively coupling (col. 6, lines 45-48) RF power into the plasma etch chamber, such that a substantial DC bias exists between the pedestal and the plasma (the limitation is written on in col. 8, lines 37-38 "500 Volts to 3000 Volts bias on the wafer" is used to refer to a bias in the same area).

As to claim 12 Desphande discloses the etching gas mixture (col. 12. line 27) comprises an inert gas (written on the limitation in line 31, "a noble dilutant" used to reference the same) selected from the group consisting of argon (col. 12, line 31), helium (line 31), neon, xenon, and krypton.

Claim Rejections - 35 USC § 102

Claims 1-2, 4-6, 9, and 12 are rejected under 35 U.S.C. 102(e) as being anticipated by Leung et al (US Patent No. 6,897,154).

The applied reference has a common assignee with the instant application. Based upon the earlier effective U.S. filing date of the reference, it constitutes prior art under 35 U.S.C. 102(e). This rejection under 35 U.S.C. 102(e) might be overcome either by a showing under 37 CFR 1.132 that any invention disclosed but not claimed in the reference was derived from the inventor of this application and is thus not the invention "by another," or by an appropriate showing under 37 CFR 1.131.

Leung also discloses a plasma etch process (ab.) for selectively etching (ab.) a layer of low-k dielectric material (ab.) having a dielectric value of less than 4 (see enclosed definition of low-k dielectric by the Semiconductor Glossary, which provides evidence that low-k is lower than 3.9) comprising: transferring the substrate into a plasma etch chamber (see col. 3, lines 37-39), exposing the low-k dielectric layer to an energizes gas(col.3, l.8-10), the etching gas mixture comprising one of more fluorocarbons or hydrofluorocarbons (as in claim 1), such as CH₃F (as in claims 2 and 6), CHF₃ (as in claim 4), CH₂F₂ (as in claims 2 and 6), or CF₄ (as in claim 4) (col.4-5, l.66-67, and 1-5).

As for claim 5, Leung discloses a nitrogen-containing gas: such as N.sub.2 or NH3 (col.4, l.36-37).

As to claim 9, Lueng discloses generating and maintaining the plasma of the etching gas comprises capacitively coupled RF power of a DC bias between the pedestal and the plasma (col.3, l.55-57).

As to claim 12 Leung discloses the etching gas mixture comprises an inert gas selected from the group consisting of argon, helium, xenon, etc (col.4, l.37-38).

Claim Rejections - 35 USC § 102

Claim 11 is rejected under 35 U.S.C. 102(e) as being anticipated by Desphande et al. of USPN 6,869,542 evidenced by Sawin et al. of USPN 5,450,205.

See teachings of Desphande above. Desphande discloses the use of a magnetically enhanced reactive etch chamber in the form of MERIE (col.11, l.61-62). However, it is silent about the apparatus having a slowly rotating magnetic field in the chamber. The disclosure of the MERIE apparatus is considered to inherently possess a slowly rotating magnetic field. See Sawin which provides evidence that MERIE operates by having a slowly rotating magnetic field in the chamber (col.10, l.50-59).

Claim Rejections - 35 USC § 103

Claim 10 is rejected under 35 U.S.C. 103(a) as being unpatentable over Desphande et al. of USPN 6,869,542 (see above) in view of Koshimizu et al. of USPN 6,426,477.

Desphande teaches use of plasma etching chambers that are either capacitively coupled with single or multiple frequencies, and inductive or resonantly coupled (col.6, l.45-49), which is written on applying a bias to the pedestal a source power to a top electrode.

Although Desphande broadly teaches use of multiple frequencies, Desphande is silent as to using of plasma etching chambers in that the source power has a greater frequency than the bias, as in claim 10.

Koshimizu teaches the configuration of a typical conventional etching apparatus includes applying the high frequency power of a source and a low frequency bias (col.1, l.28-50).

It would have been obvious to one of ordinary skill in the art at the time of invention was made, to apply high frequency power of a source and a low frequency bias, as in Koshimizu, when using the capacitively coupled configuration of Desphande to etch a low-k dielectric material, because Koshimizu teaches the configuration of a typical conventional.

Claim Rejections - 35 USC § 103

Claims 7 and 8 is rejected under 35 U.S.C. 103(a) as being unpatentable over Desphande (see discussion above).

See teachings of Desphande above.

It would have been obvious to one ordinary skill in the art at the time of invention was made, to select any volumetric flow rates/ratios of the disclosed etching gases that

Claims 7 and 8 are rejected under 35 U.S.C. 103(a) as being unpatentable over Desphande (see discussion above) in view of Su et al (US Patent No. 6,828,251) in further view of Becker et al (US Patent No. 6,287,978).

Desphande teaches a gas mixture of fluorocarbons, nitrogen, and hydrofluorocarbons, but is silent as to volumetric flow rates and gas ratios, as applicants' claims 7 and 8.

Su teaches several aspects of the claimed invention including all the features of the base claim. Su teaches on the limitation the etching gas mixture is introduced into the plasma etch chamber in col. 3-4, lines 67, and 1-3 "providing an ambient conducive to forming a plasma including at least nitrogen and at least one compound selected from the group consisting of fluorocarbons and hydrofluorocarbons".

Su also teaches by that introducing the fluorine-rich fluorocarbon or hydrofluorocarbon gas at a first volumetric flow rate [(20-100 sccm) col. 4, line 20], the nitrogen-containing gas at a second volumetric flow rate [(50-300sccm) col. 4, lines 21-22]. Su teaches ranges sufficient to vary so that the ratio of the second volumetric flow rate to the first volumetric flow rate is about 1:4 to 2:1.

Although Su teaches the presence of hydrogen-rich hydrofluorocarbon gas, Su is silent as to the volumetric rate (col. 4, line 2-18).

Becker teaches selective etching of a silicon dioxide layer (col.1, line 17-18) where 14 sccm of CH₂F₂ are added (col. 7, line 25-26). Becker also teaches ranges sufficient to vary so that the ratio of the third volumetric flow rate to the first volumetric flow rate is about 1:3 to 1:1.

Art Unit: 1765

would be effective for accomplishing the desired degree of etching, including the specific volumetric flow rates/ratios claimed by applicants because the disclosure of Desphande is considered to encompass any functional ranges since it does not particularly limit the combination/ratio employed. In absence of unexpected results, applicants' claimed ranges are considered to be encompassed by the broad disclosure of gasses.

Claim Rejections - 35 USC § 103

Claim 13 is rejected under 35 U.S.C. 103(a) as being unpatentable over Desphande (see discussion above).

See teachings of Desphande above.

It would have been obvious to one ordinary skill in the art at the time of invention was made, to select any combination/ratio of the disclosed etching gases that would be effective for accomplishing the desired degree of etching, including the specific combination/ratio of gases claimed by applicants because the disclosure of Desphande is considered to encompass any functional ranges since it does not particularly limit the combination/ratio employed. In absence of unexpected results, applicants' claimed ranges are considered to be encompassed by the broad disclosure of gasses.

Response to Remarks

The applicant responds on November 11, 2005 to office action of July 1, 2005.

Applicants' arguments with respect to the 112, 2nd paragraph rejection are noted. However, the rejection is not withdrawn because the current version of claims could be interpreted differently from applicants' explanation. It is suggested that applicants amend the claim language to reflect the specific combination of components they intend to claim.

Claims 1-2, 4-6, 9, and 12 stand rejected as being anticipated by Desphande, et al. of USPN 6,869,542. Applicants assert that Desphande teaches and suggests only the selection of one of the gases contained in each of a nitrogen gas, a fluorocarbon, an oxidizer, and a noble diluent (col.12, l.23-31), but there is no teaching that indicates that multiple gases may not be selected from any of the categories of gases, in the disclosed etching mixture. Applicants' arguments on page 9 of the response regarding the assertion that Deshande only disclose selecting one of the gases contained in each of a nitrogen gas, fluorocarbon, oxidizer, and noble diluent are not persuasive in overcoming the pending rejection because the specific combination of components in the applicants' claims is indefinite. Applicants can not distinguish the claims with limitations that are not included in the claims.

Claims 3, 7-8, and 13 stand rejected as the rejection of claim 1 stands.

Rejection for claims 10-11 withdrawn as examiner agrees with applicants that the prior art of Hoffman et al., may not preclude patentability under 35 USC 103. Please note the rejection in the action above.

Conclusion

The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

US Patent Nos. 6,410,451; 6,090,403; 6,362,109; US Patent No. 6,014,943; 6,828,251; 6,287,978; 6,451,703.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Patricia A. George whose telephone number is (571) 272-5955. The examiner can normally be reached on weekdays between 7:30am to 4:00pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nadine Norton can be reached on (571) 272-1465. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

1205
PAG

NADINE G. NORTON
SUPERVISORY PATENT EXAMINER
